Water without borders
-Wednesday 22 March

The importance of minerals in drinking water -Reverse Osmosis treated drinking water and health

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You were once taught not to drink the distilled water in the lab. What now?

During the 18th and 19th century, the upper classes spent days or weeks at resorts, drinking (or bathing in) "health bringing" water. Different water types were assigned different healing properties, as for instance, water with elevated bicarbonate were visited by people suffering from stomach pains, sulfate was good against constipation, water containing sulfate and magnesium relieved pains from gallstones, iron rich water was good for anemia etc. Nowadays, Reverse-osmosis treated water (RO) is increasingly used to meet demand for drinking water in communities in coastal and other arid areas around the Baltic Sea, as in other parts of the world. For example, in Väster Haninge, one east coast municipality, there are around 50-100 private RO systems and 2 municipal RO plants serving about 250 households with water, with another planned for 250 households. In Norrtälje municipality there is one municipal RO plant and around 20 private or community-managed systems. On Gotland RO plants are running and new ones are planned for, and Öland starts one plant this summer.

Despite its increasing use, knowledge about potential consequences to health from drinking RO water are rarely discussed in communities. RO water is completely demineralized, comparable with rain water or distilled water; even pH-adjusted RO, to decrease pipe corrosion, is extremely low in minerals and corrosive. Consuming RO water is associated with an increase in excretion of major intra- and extracellular ions from the body fluids. Short-term consumption may cause nausea, weakness, trembling, coma and even death due to lack of electrolytes, Na and K. Long-term consumption is associated with cardiovascular disease, osteoporosis, diabetes, pre-term birth, low birth weight and some forms of cancer. Communities using or considering using RO systems should: (i) learn about potential health consequences; (ii) analyze current water supply quality parameters, compare it with RO water, and considering mixing; (iii) consider re-mineralization of RO water. Authorities should consider guidelines for minimum concentrations of major minerals in RO water (e.g. Ca 20 mg/L, Mg 10 mg/L, and HCO_3 100 mg/L).

The use of RO water in Saudi Arabia is immense. However, during a visit to CACST University in Riyadh, Saudi Arabia, January 2017, I found out that water distributors always mix the RO water with ground water from underneath the desert. Thus, TDS (Total Dissolved Solids) is never beneath 100 mg/L, and the Riyadh drinking water had total hardness 10 °dH, which is twice as much as the Stockholm Water.

Among other studies I have studied women drinking low-mineral acid well water and compared them with women drinking hard alkaline well water. Ca was 6 times higher in well waters and hair of women drinking hard alkaline water, and they reported much less negative health changes during the time they had been drinking their special well water. Another study includes drinking water and hair nutrient analyses of people shifting from their own well water to RO water on Möja Island in the Stockholm archipelago to be compared with water and hair minerals after drinking RO water for one year and five years, respectively. At present, water and hair of 14 people have been evaluated after one year of drinking RO water. Hair Na and V rose, while Fe, Mn, Cr and Se decreased compared to levels while people were drinking their own well water.

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PhD Ingegerd Rosborg
Land and Water Resources Engineering
KTH

Christian Jöhncke

- Head of Water & environment, NCC Infrastructure
- Responsibility within NCC:
  - No dig techniques
  - Water treatment plants
- Sailor living in Gothenburg
- Drinks too much, water

Water challenges

- 1.700 waste water treatment plants
- 100.000 km waste water pipes
- 1.750 water treatment plants
- 70.000 km water pipes

- Renewal rate is too low

Svenskt Vatten

the Swedish Water & Wastewater Association (SWWA)

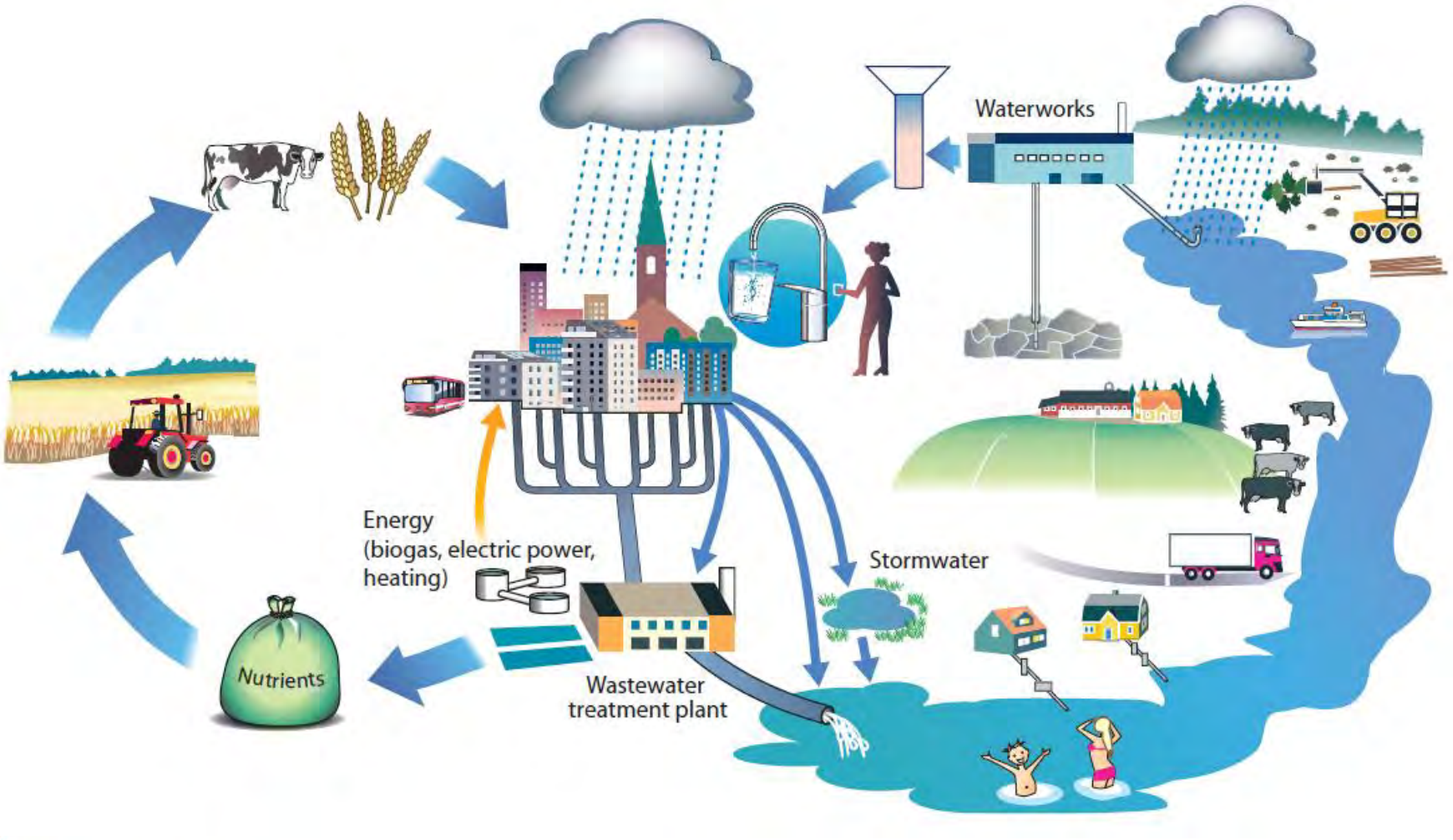
Daniel Hellström
@SVUtveckling

Svenskt Vatten

Vision (=what SWWA want to achieve)

Sweden should have fresh drinking water, clean lakes and seas and access to long-term sustainable water services.

Water, Nutrients and Energy – the loops of water management



A VISION FOR WATER

Most important R&I-needs

- Safe and secure drinking water supply
- Climate mitigation and adaption
- Resource efficient wastewater & stormwater systems for improved environment and resource recovery
- Sustainable management of water infrastructure

A VISION
FOR WATER

Offers from SWWA

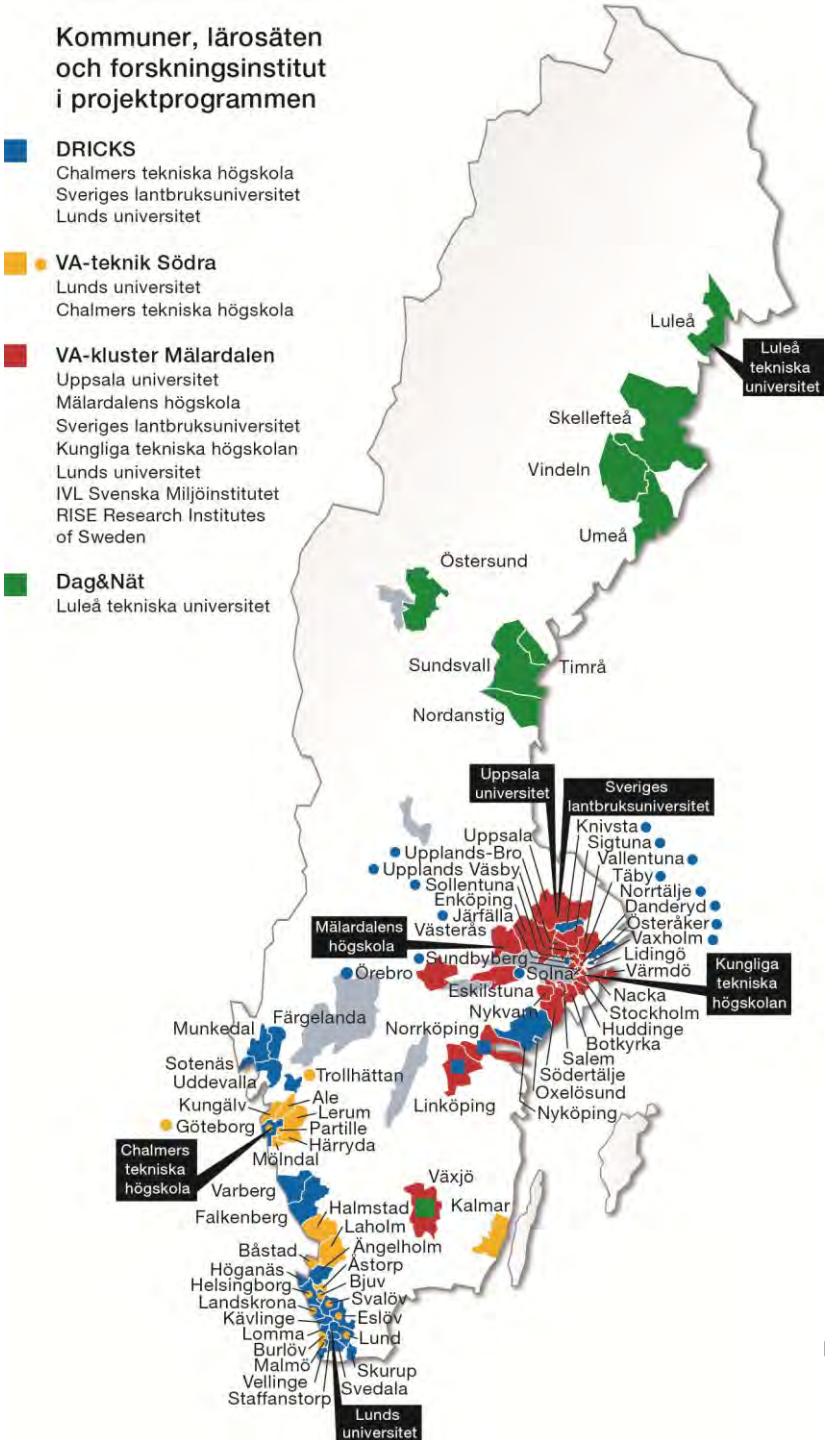
- Help to connect relevant research to existing research programs/clusters and/or water utilities
- Co-funding
- Dissemination of results.

Svenskt Vatten

R&D program/cluster supported by SWWA

- Dag&Nät
- DRICKS
- VA-teknik Södra
- VA-kluster Mälardalen

Annual turnover:
~100 MSEK
(8 MSEK from SWWA)



Evaluation 2014

The establishment of the University-program in SWWA R&D has been a great success. Not only has the extent and quality of Swedish R&D in the water and wastewater sector increased considerably, but the contact between the members of SWWA and the R&D groups has been substantially improved as well.

Hallvard Ødegaard, prof. em. NTNU

Svenskt Vatten

Elzbieta Plaza, professor

The research group

Water, Sewage and Waste Technology

Develop and apply knowledge to improve municipal water and sewage handling.

Focus on treatment methods combined with recovery of resources.

Senior scientists:

- Elzbieta Plaza, Professor
- Erik Levlin, Docent (associate professor)
- Jozef Trela, PhD, Senior researcher

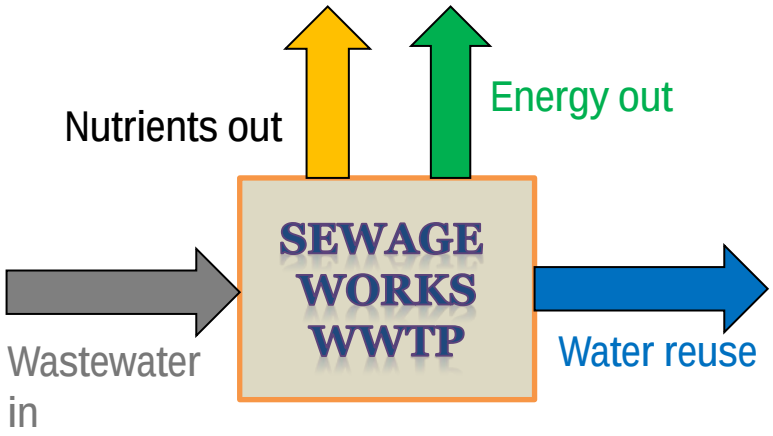
PhD students

Post docs

Master students

Water, Sewage and Waste Technology
Division of Land and Water Resources Engineering
Dep. of Sustainable development, Environmental science and Engineering
School of Architecture and the Built Environment
KTH, Royal Institute of Technology

Future WWTP



Achievements at SSV:

45 Master Thesis

2 PhD Dissertations

3 Lic. Thesis

4 Post docs at SSV

KTH VETENSKAP OCH KONST

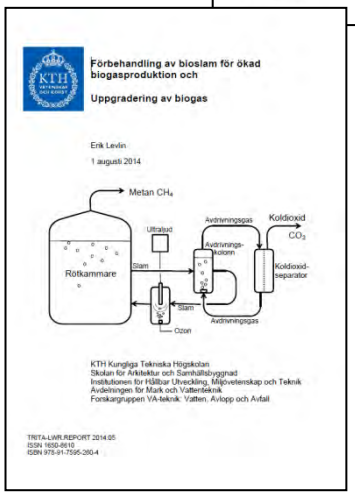
Hammarby Sjöstadsverk
Research and innovation for clean water

ivl

Erik Levlin docent

Research projects

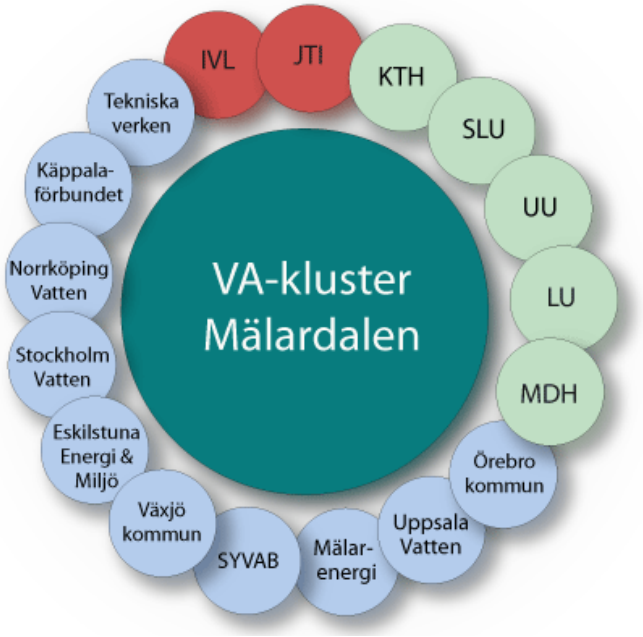
- Phosphorus recovery from side stream at Bio-P treatment
- Increased efficiency of biogas production
- Biogas production from fish waste
- Future Wastewater Treatment
  - Phosphorus recovery
  - Biogas production and upgrading
- Reduce greenhouse gas emissions from Swedish wastewater and sewage sludge management



Erik Levlin docent

Research projects

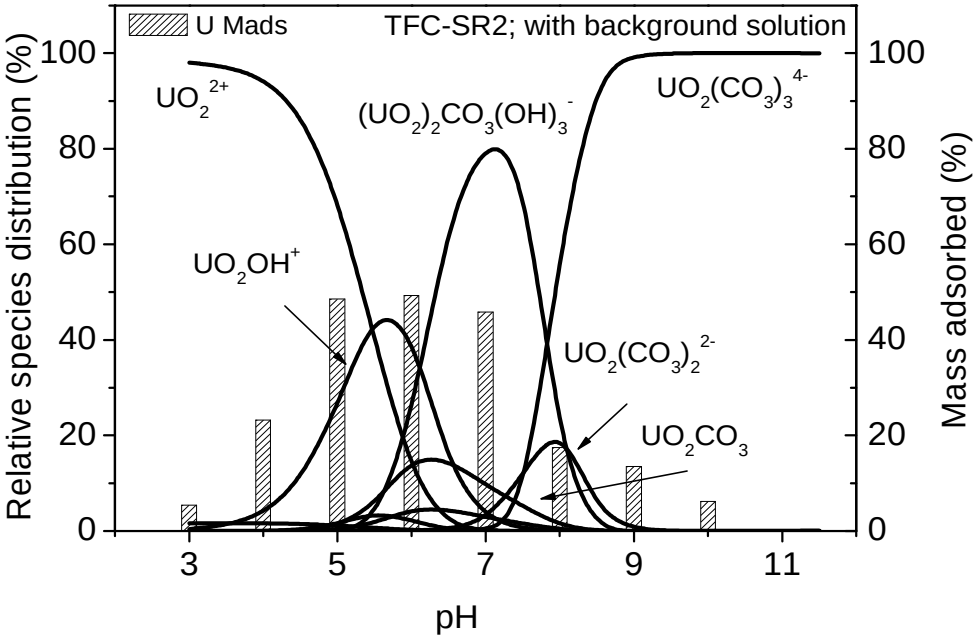
- Anammox process for nitrogen removal
  - Reject water
  - Main stream
- Combined Sewer Overflow treatment



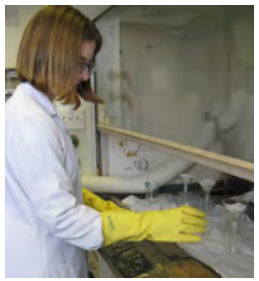
VA-kluster Mälardalen

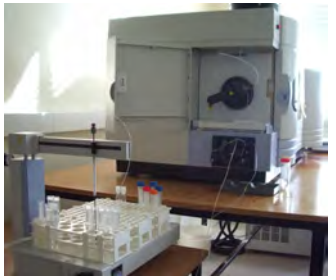
Cooperation network for research and education in sanitary engineering with Universities research institute and municipal wastewater organizations in Mälardalen region.

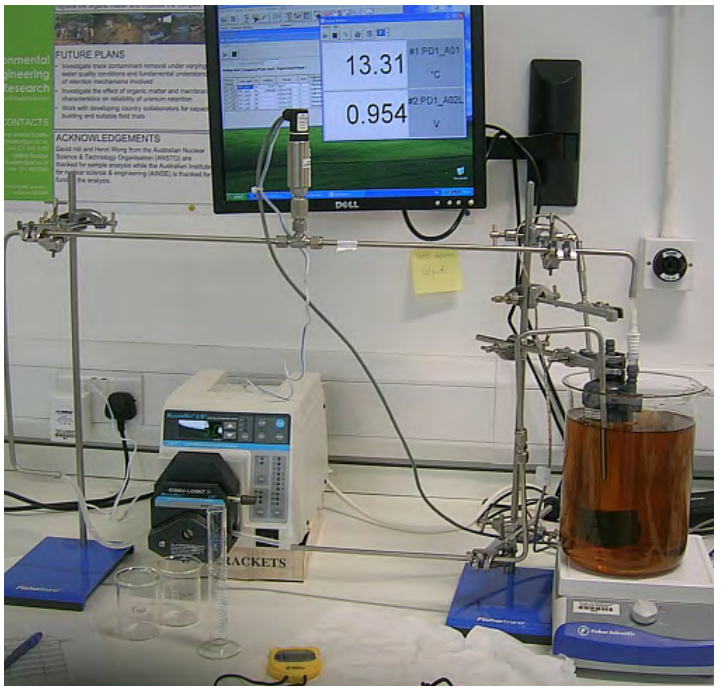
Miljökemi - uran, fluorid, arsenik, silver nanopartiklar
Vattenreningsteknik - membran, förnybar energi



2016 ES&T, 2016 Sust Energy, 2016 Desalination, 2010 Sci Tot Env, 2010 J Memb Sci, 2010 Sep Purif Technol, 2009 Desalination





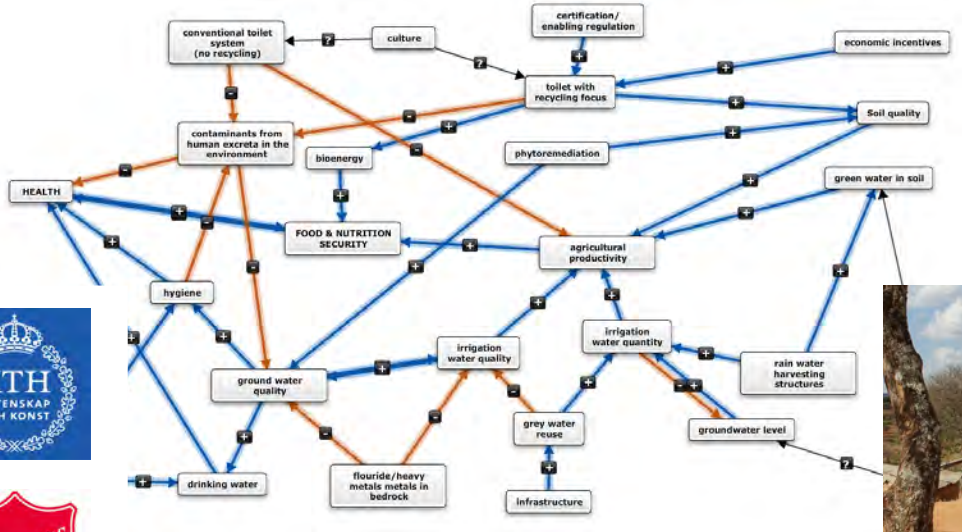


THE UNIVERSITY of EDINBURGH

Samverkan - Vatten & sanitet för mat- och näringssäkerhet
Kapacitetsutveckling – resiliens, vattenkvalitet

Linking water-sanitation-farming sectors for food and nutrition security (2017)

Capacity development for operationalising resilience in the Salvation Army Sweden, Kenya, Malawi (2017)



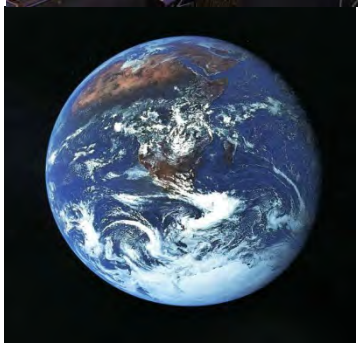
KTH VETENSKAP OCH KONST

FRÄLSNINGS ARMÉN

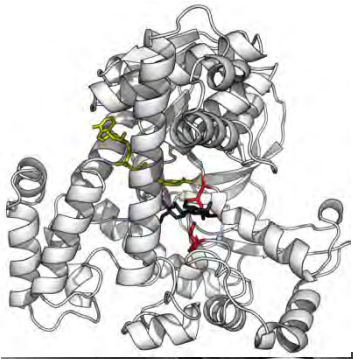
SIANI
Swedish International Agricultural Network Initiative

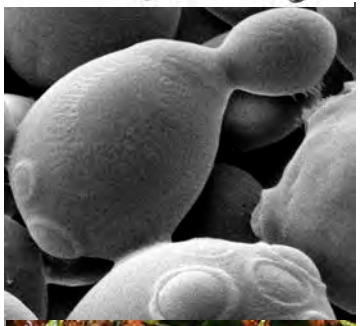
Helfrid Schulte-Herbrüggen
hschulte@kth.se

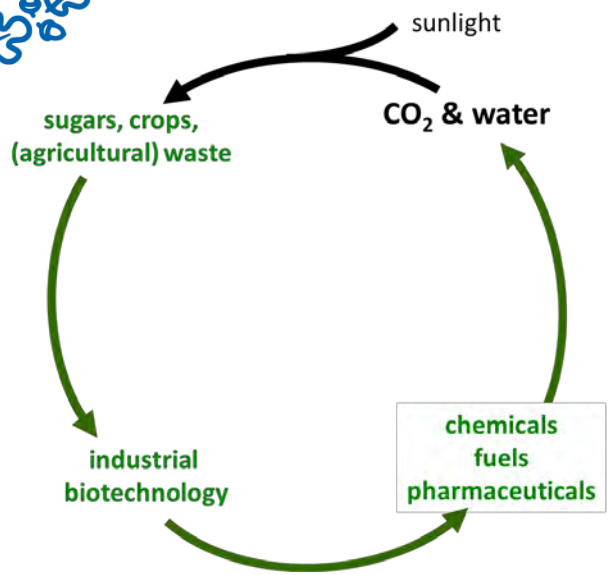
Industrial Biotechnology Division @ KTH



KTH
VETENSKAP
OCH KONST







Water research in Industrial Biotechnology Division @ KTH

- General Microbial Physiology
- (Waste) Water treatment:
  - Microbial treatment of waste streams
  - Ozonation (+pilot)
  - Carbon treatment (+pilot)
  - Filtration
  - Melanin-based removal of xenobiotics
  - Protein-based coagulation
- Impact and persistence of xenobiotics
- From ‘waste’ to resources
- Bioprocess development

Berndt Björlenius

Gunaratna Kuttuva Rajarao

Ton van Maris

Karina Barquet, Research Fellow Stockholm Environment Institute (SEI)

I have a background in Human Geography (PhD), Development Studies (MsC), and Peace and Conflict Studies (Ba). My research focuses on the political and social dimensions of environmental governance. Key themes include environmental security, transnational governance, political ecology, border studies, and politics of scale. In my work, I have explored the ways in which global discourses of risk, environmental governance, and security are translated and understood in specific geographies, and how local needs and responses to global changes can in turn shape policy. I am particularly interested in how the interrelation between different environmental challenges coupled with political processes interacts and translates into threats across scales. My current research ambitions are therefore to further explore these interactions, the risks and opportunities they pose, and potential actions necessary to respond to these risks. Water, is one of the overarching links and has been a key theme in past and current research.

Some of my work has been research-oriented, for instance, to understand the role of transboundary conservation as a peacebuilding tool between states, or to explore the implications of the politics of scale inherent in multi-scalar governance models like transboundary conservation. More recent work is more applied and solution-oriented research, for instance to explore solutions to coastal risks, to increase participation in the management of risks, or to explore policy and institutional constellations to deal with multi-level governance frameworks.

Methodologically I have often been part of multidisciplinary teams and applied mixed methods, including geographical analysis (GIS), statistical studies, ethnographic methodologies, and participatory and co-creation approaches to facilitate stakeholder inclusion and participation. I have field experience in post-conflict contexts in Latin America, in different parts of Europe, and have researched on diverse development issues in Africa. I am currently working with the implementation of the Sustainable Development Goals in Colombia; with two disaster-reduction projects in Europe, RISC-KIT and EDUCEN; and I am part of the SEI-led project RETURN, a Blue Baltic Bonus financed initiative on technical and institutional solutions to water pollution.

My teaching experience includes subjects of Human Geography, Development Studies, African Studies, Latin American Studies, and Environmental Studies from universities in Europe and Central America. Earlier, I engaged with local capacity building, democracy building, disaster relief, and poverty reduction projects in Latin American countries.

PUBLICATIONS

(Peer-reviewed)

- **Barquet K**., Meijer J.J., Dickin S. Forthcoming. Piloting RISC-KIT's integrated approach for understanding vulnerability in the coast of Kristianstad, Sweden. Special Issue in Coastal Engineer
- **Barquet K**., Cumiskey L., Paolisso M. Forthcoming. Co-producing knowledge: participatory methodologies for assessing disaster risk reduction measures. Special Issue in Coastal Engineer

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(Other)

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MARCO REGAZZONI

- KTH ALUMNI (2010)
- GENERALIST
- INTERESTED IN CITY PLANNING

& LOTS MORE…

CURRENT PROJECTS

- Borlänge – City development program
- Arlanda - Development project
- Nyköping - New train station
- Heby – New municipal groundwater supply
- …

SWECO GROUNDWATER

- INFRASTRUCTURE PROJECTS
- URBAN DEVELOPMENT PROJECTS
- MUNICIPAL AND COOPERATIVE GROUNDWATER SUPPLY
- GEOENERGY
- WATER RESOURCE PLANNING
- …

Challenges

- Densification of cities
- Climate change and drought
- Presentation of results - uncertainties
- Surface water/ groundwater interaction
- Estimating groundwater leakage to rock
- Too much work – too few professionals
- Time plans

Marianne Kjellén
Senior Water Advisor
UNDP

Water & Oceans
Governance Programme

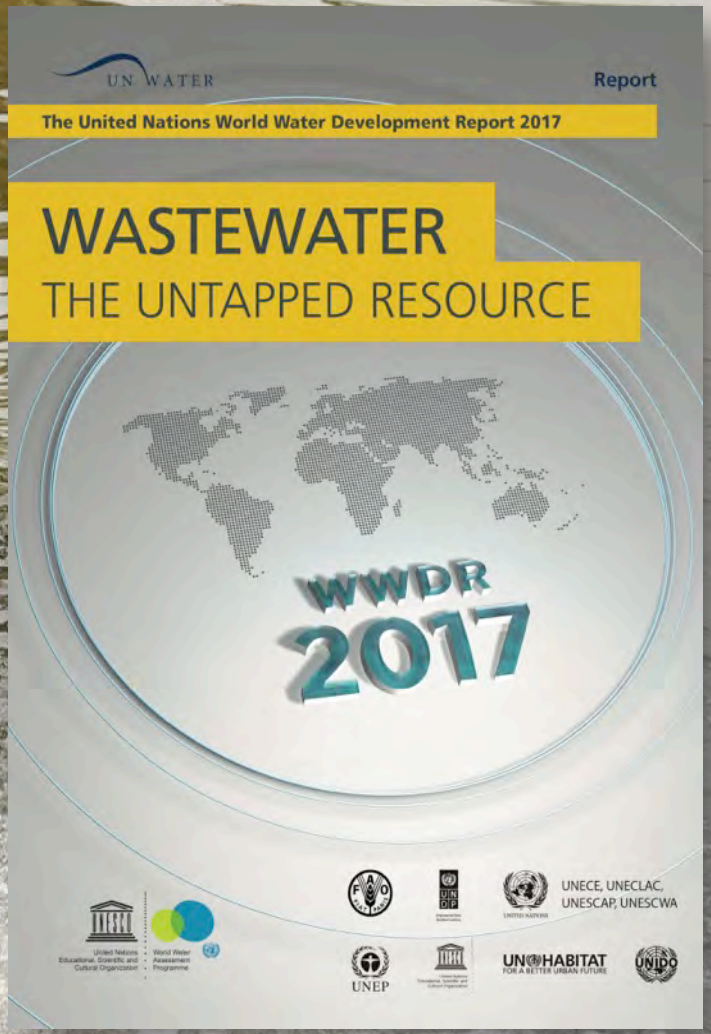
SDG 6 & SDG 14

UNDP

Empowered lives.
Resilient nations.

Världsvattenrapporten 2017

Avloppsvatten: en underutnyttjad resurs



UNDP
Empowered lives.
Resilient nations.

marianne.kjellen@undp.org

UNESCO
United Nations Educational, Scientific and Cultural Organization

World Water Assessment Programme

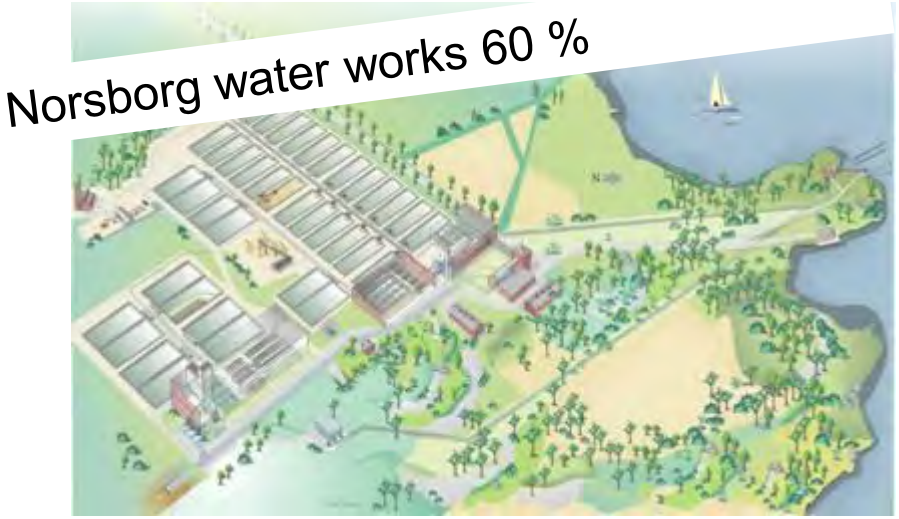
UN WATER

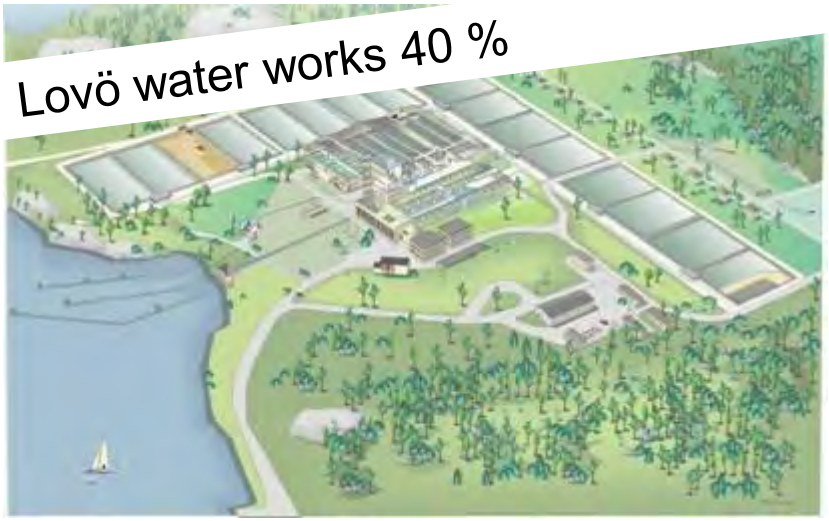
Challenges for drinking water supply

STOCKHOLM
VATTEN
OCH AVFALL

Two water works using surface water from lake Mälaren

- Water production for ~1,4 million people





150 000 000 m^3 /year

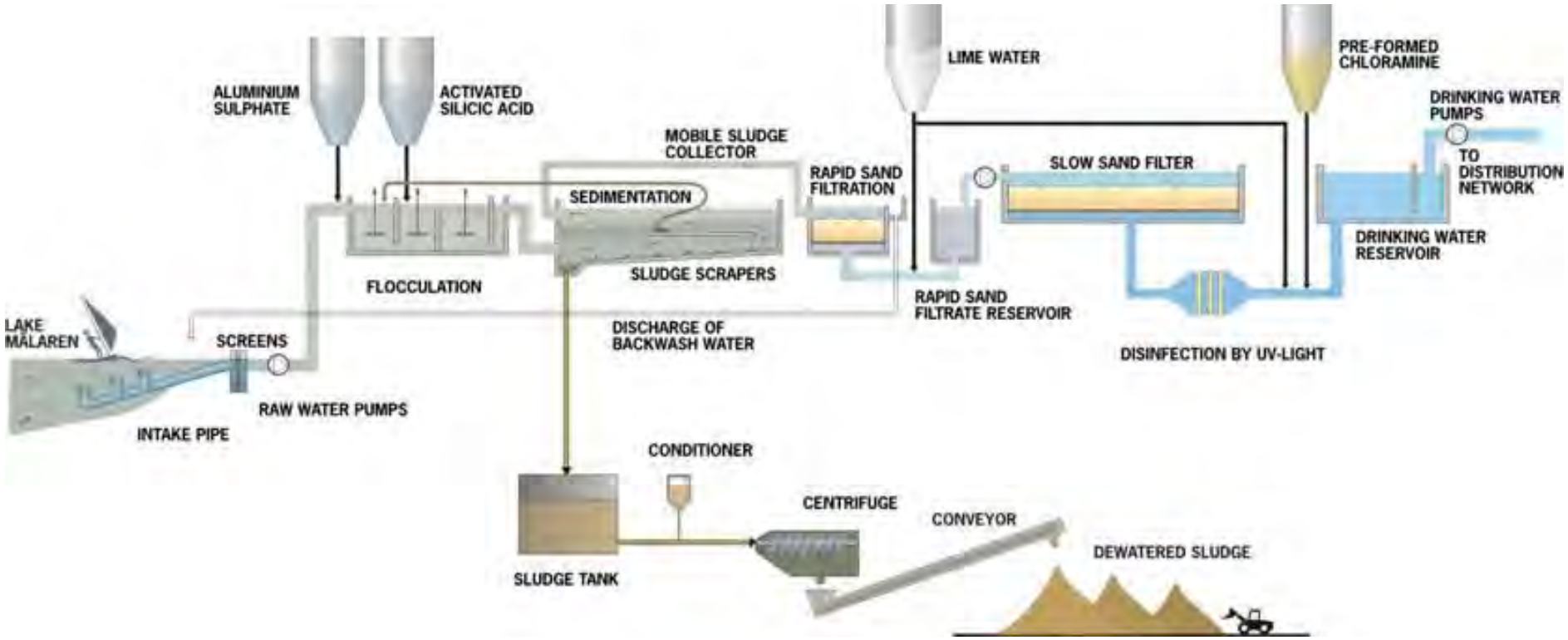
410 000 m^3 /day

17 000 m^3 /h

STOCKHOLM VATTEN OCH AVFALL

Who are we and what do we do?

- Process development (drinking water) has 8 employees
  - Laboratory engineers – analyses the water quality through the treatment processes
  - R&D engineers- process optimisation and development



STOCKHOLM VATTEN OCH AVFALL

Challenges: present and future

- Large raw water source- many influencing factors and potential risks.
- Population growth - need to increase the capacity
- Old water works, reservoirs and distribution network
- Difficult to make repairs while still running the process
- No barrier against chemical pollutants and petroleum products
- In need of more knowledge and faster/better detection methods for microbiological contaminants (virus..)
- Finding experienced consultants, entrepreneurs and contractors

Catchment area: 22 600 km^2
Surface Area: 1 100 km^2
Run off: 5 billion m^3/year

STOCKHOLM VATTEN OCH AVFALL

Research Funding

KTH- International-Groundwater Arsenic Research Group, SEED

Focus on groundwater research: geogenic contamination, sustainable mitigation and management

Sida

MISTRA
STIFTELSEN FÖR MILJÖSTRATEGISK FORSKNING

KTH VETENSKAP OCH KONST

formas

Vetenskapsrådet

SGU
Sveriges geologiska undersökning

Water JPI

AgriAs

Prosun Bhattachaya

Professor, Research Leader
Groundwater Chemistry

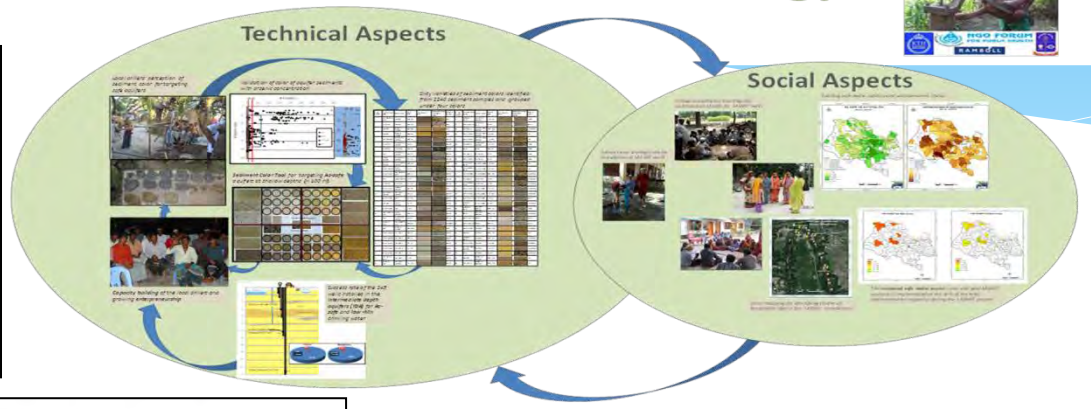
Focus on Groundwater research at SEED
KTH-International Groundwater Arsenic Research Group

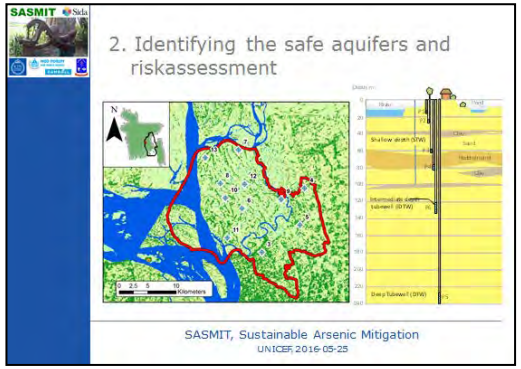
- KTH is one of the pioneers, who have initiated and pursued research on groundwater resourecs across the world.
- From international standpoint, KTH-IGARG plays a key role in pursuing high quality research on groundwater and strong international network.
- Since 1993, the group is actively involved with research on geogenic contamination in groundwater resources in Asia (Bangladesh, India, Nepal), Latin America (Argentina and Bolivia), Africa (Tanzania and Ghana) and Europe (Sweden and the EU), namely:
  - Fluoride
  - Arsenic
  - Radionuclides – uranium and thorium
- Our focus has been to understand the hydrogeochemical processes in the aquifers leading to the mobility of contaminants and develop sustainable mitigation options.

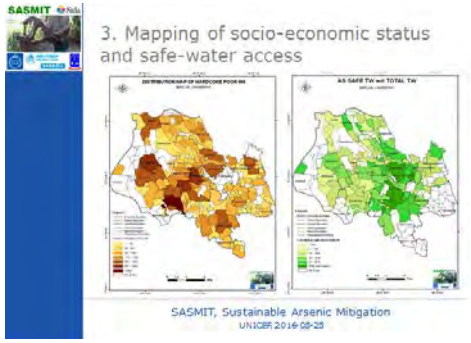
Sustainable Arsenic Mitigation (SASMIT)

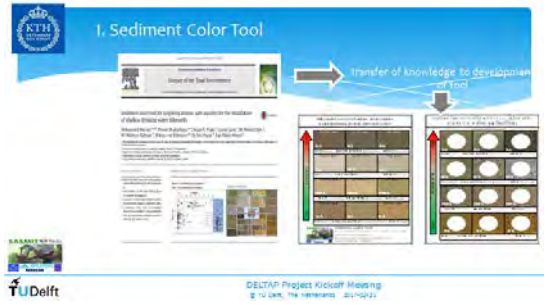
Collaborative partners: Dhaka University, NGO Forum (Bangladesh) & Ramböll Sweden

The SASMIT Strategy







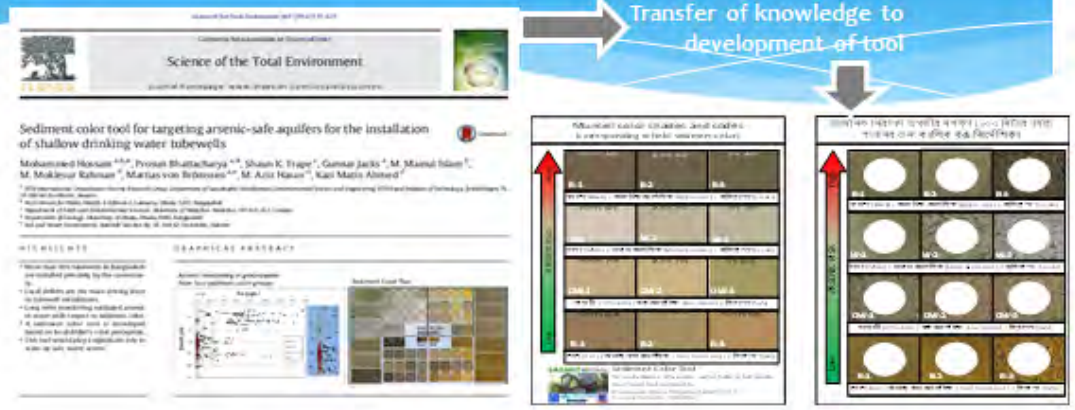


Major Highlights

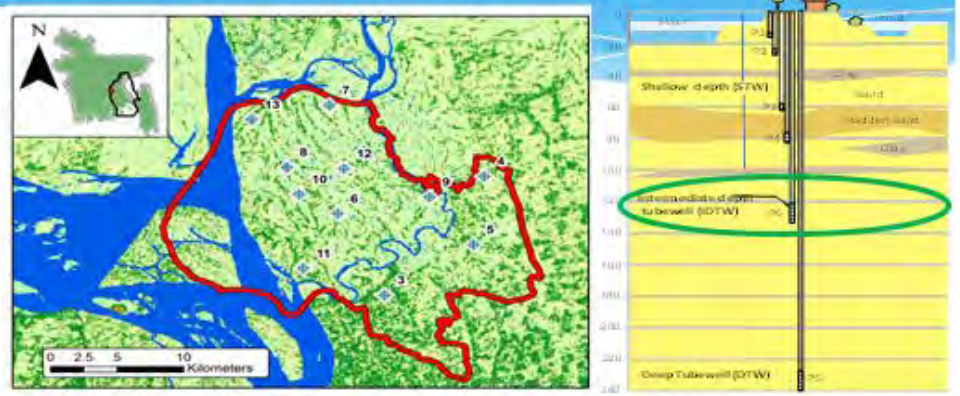
- Increase global awareness of the environmental health problems associated with high As groundwater of geogenic origin,
- Developed sustainable option(s) for installation of safe drinking water wells for rural and disadvantaged community through targeting safe aquifers in regions with high As groundwater based on sediment colour concept and related hydrogeological characteristics

SASMIT Innovations

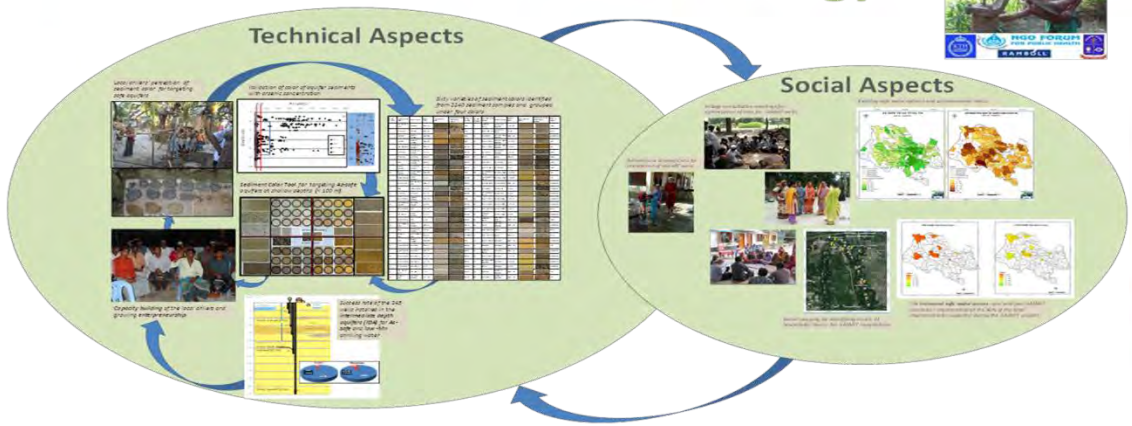
I. Sediment Color Tool



II. Intermediate Deep Tubewells (IDTW)



The SASMIT Strategy



SASMIT Sida

NGO FORUM FOR PUBLIC HEALTH
RAMBOLL

SUSTAINABLE DEVELOPMENT GOALS

KTH and Global Groundwater Arsenic Research Network

University of Kalyani, India (1996-

University of Dhaka, Dept. of Geology (1998-

Envionmental Sciences (2000-
UNIVERSITY OF HELSINKI

Universidad Nacional de Santiago del Estero (UNSE) Dept. of Geology (2001-

Jawaharlal Nehru University, New Delhi (2004-

India Institute of Technology-Bombay, Department of Earth Sciences (2001-

India Institute of Technology-Guwahati (2005-

School of Studies in Chemistry, Pt. Ravishankar Shukla University Raipur, Chattisgarh India (2007-

Center for Water Resources Development and Management, Kozhikode, Kerala (2004-

UNIVERSITY OF SOUTHERN QUEENSLAND

NGO FORUM FOR PUBLIC HEALTH

KWR

GTK gtk.fi

RAMBOLL

University of Dar es Salaam, Tanzania

1. **Sida:** Sustainable Arsenic Mitigation (SASMIT) [2007-2011] Sida Contributon 73000854, (11 MSEK);
2. **Mistra:** Targeting As-safe aquifers in regions with high arsenic groundwater and its worldwide implications [2006-2010]
3. **SGU:** Arsenik i Svenska grundvatten- mobilitet och risk för naturligt förhöjda halter.[2007-2008]
4. **VR-Sida SRLProgramme:** Targeting safe aquifers in regions with high arsenic in groundwaters of India and the options for sustainable drinking water supply [2007-2009]
5. **Formas project:** Pilot scale evaluation of soil washing for treatment of arsenic contaminated soil (PSEMA).[2007-2012]
6. **Joint Formas-SAREC Project:** Groundwater arsenic in Chhattisgarh, Central India and options for sustainable arsenic-safe drinking water supplies [2007-2011]
7. **Sida Research Cooperation:** Water Resources Management-Hydrogeochemistry Sida Contribution 7500701606 [2007-2018 ongoing] (5 MSEK)
8. **Sida Research Cooperation: DAFWAT**: Development of affordable adsorbent systems for arsenic and fluoride removal in the drinking water sources in Tanzania (DAFWAT) [2015-2020] Sida Contribution 51170072 (16 MSEK)
9. **H2020** : Water JPI -Sustainable management of water resources in agriculture, forestry and freshwater aquaculture sectors

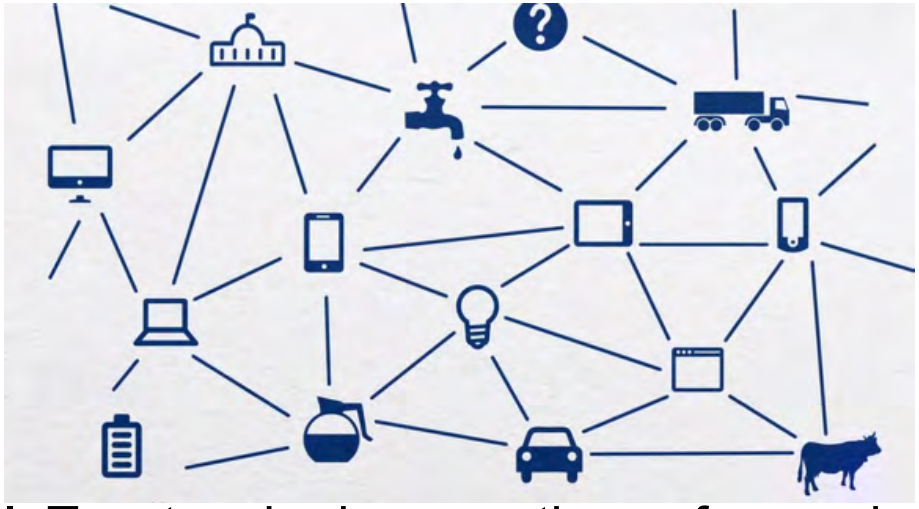
AgriAs: Evaluation and management of As contamination in agricultural water and soil (FIN-D-F-SE) (10 MSEK)

THANK YOU!

IoT in Monitoring Water Networks

Rong Du, Carlo Fischione
Department of Network and Systems Engineering, KTH

Internet of Things



- IoT: networked connections of everyday objects
  - ❑ sensors, actuators, home appliance, vehicles, mobile devices, etc.
- Research problems:
  - ❑ networking, sensing, control, computing, etc.
- Applications:
  - ❑ environmental monitoring, healthcare, transportation, smart buildings/home
- Protocols:
  - ❑ BLE, RFID, WiFi, Zigbee, LTE, NB-IoT, LoRa, etc.

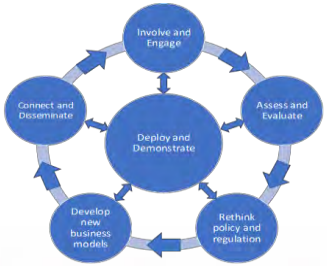
Research Interests (monitoring water networks)

- System design:
  - ❑ node deployment problem
- Networking
  - ❑ sensing scheduling and routing for prolonging network lifetime
  - ❑ wireless energy transmission
- Computing
  - ❑ machine learning for leakage/pollution detection

Rupali Deshmukh (Project Manager at IVL)
Bachelor's in Civil Engineering and Master's in Environmental Enginerring and Sustainable Infrastructure from KTH
Rupali.deshmukh@ivl.se
+46725295481

Water Without Borders

Knowledge from Hammarby Sjöstadsverk



Circular Economy

Waste Water Treatment plant

Gotland Water Problems

Prefesibility Study

Integration of Water Management Systems

Small Scale Desalination Plant

Rainwater Harvesting

Sustainable Develoment

Water Conservation through local intervention

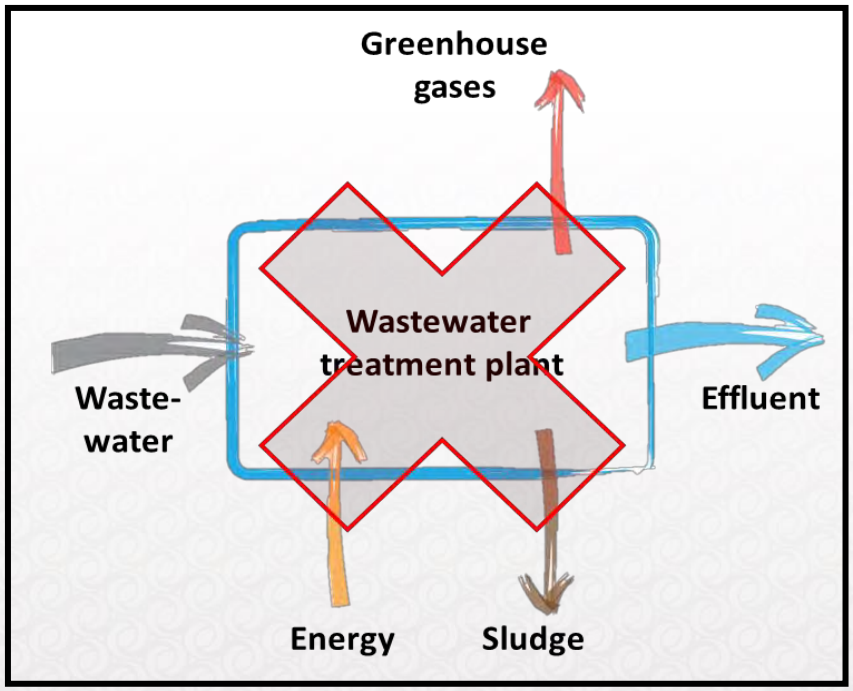
Knowledge from Case study in India

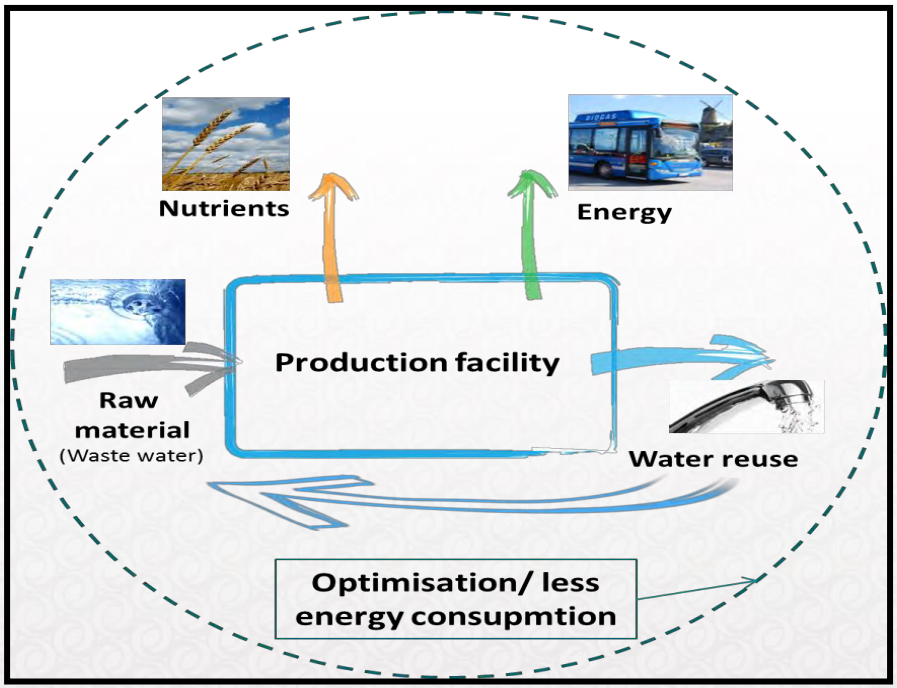
ivl

Hammarby Sjöstadverket

IVL + KTH

Conversion of Waste Water Treatment Plants to Production Facilities





Water and Sanitation for all: SDG 6

Putting WASH in the water cycle?

Karina Barquet, Sarah Dickin, Sif Johansson, Magnus Land
Stockholm Environment Institute

Target 6.1, 6.2

Household water and sanitation insecurity in Burkina Faso

- Who is most vulnerable to household water and sanitation insecurity?
- What adaptation strategies are used?

- Household water insecurity
  - Gender-based vulnerabilities due to different water uses
    - Scarcity impacts water for household and livestock use
    - Extreme events (floods, droughts) have large impacts (damage to fruit producing trees, fields), family members migrate for work

Examples of coping strategy:

- Women reduce use of well water for productive activities (Mossi ethnic group), e.g. less vegetable growing, production of products for sale (shea butter, snacks, beer)

The Telegraph

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Business

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Business

What is causing the 2017 vegetable shortage and what does it mean for consumers?

share

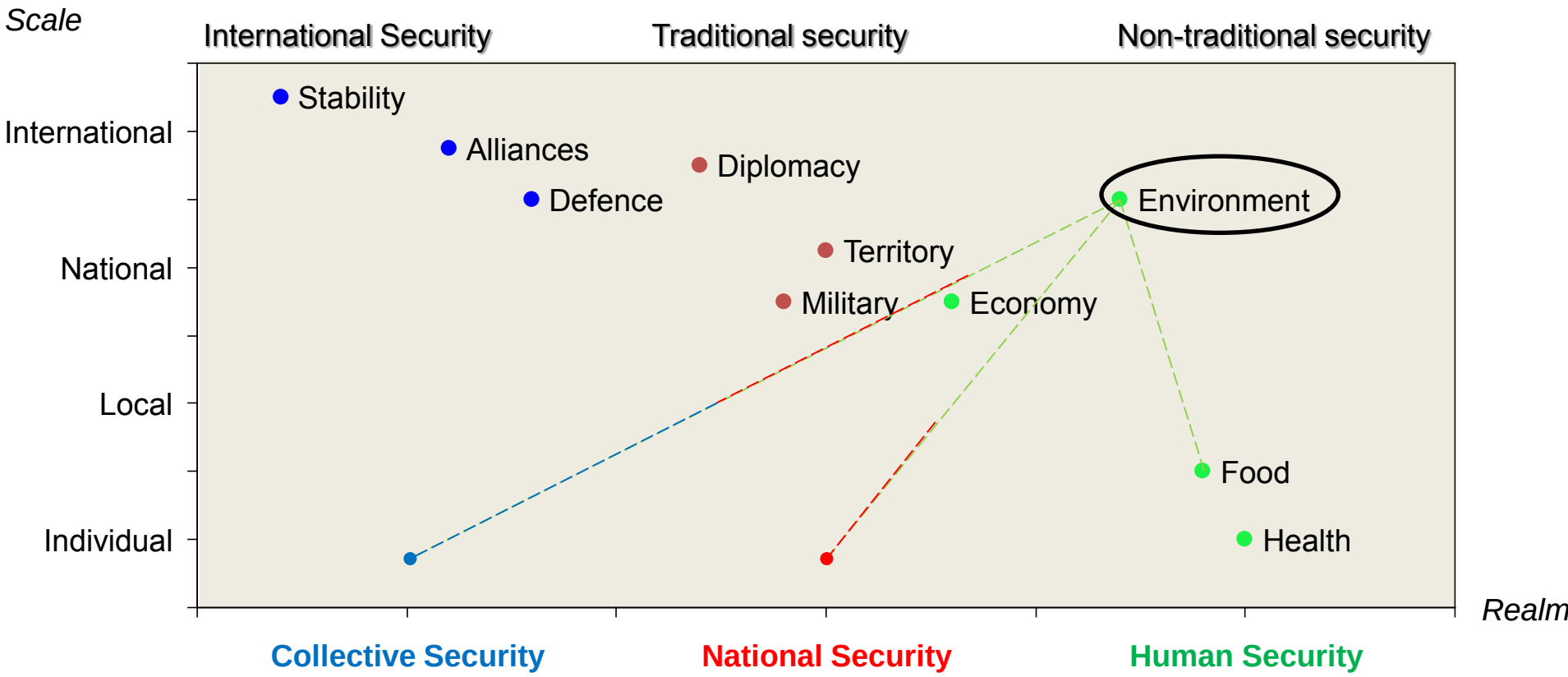
3 Comments

The cause

In short, the weather is to blame. Countries in the Mediterranean have suffered what has been described as the "perfect storm" of poor growing conditions, including horrific floods on the south-eastern coast of Spain that took the lives of five people before Christmas.

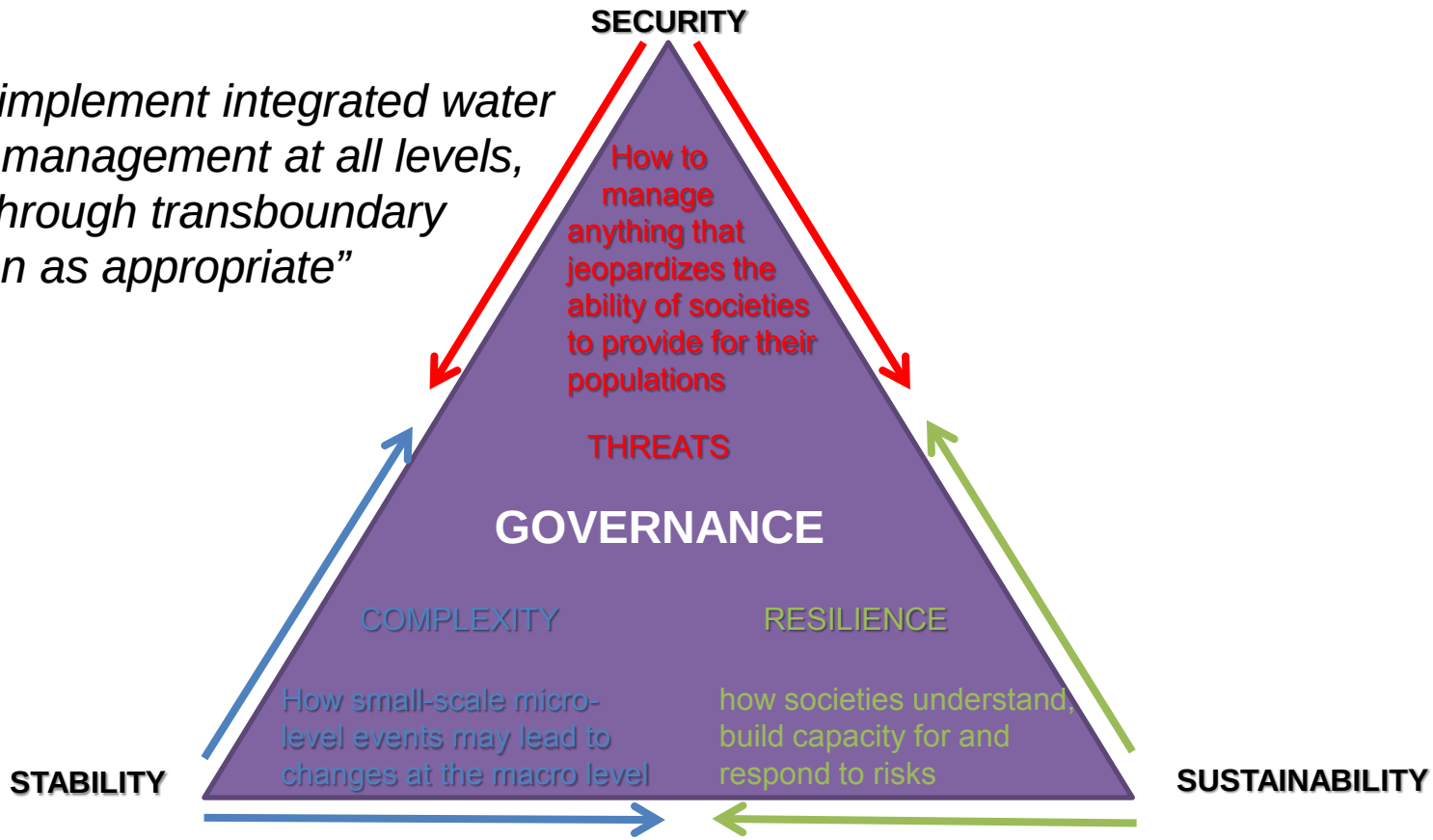
Morrisons has been helped by its vertically integrated model, which is unique among the 'big four' supermarkets. The model means it deals with many farmers directly and has its own farm, as well as food factories and abattoirs.

Security linkages



An approach to water risks across scales

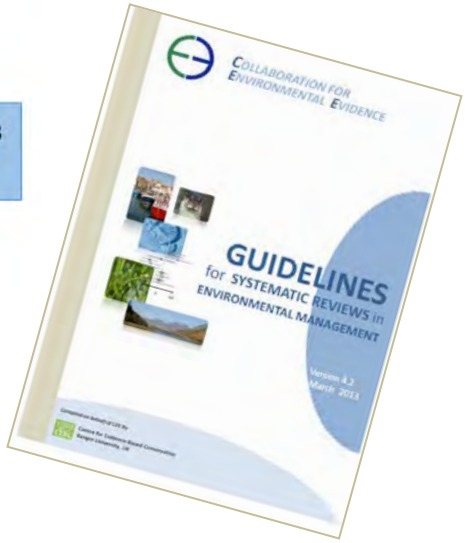
SDG 6.5
"By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate"



MISTRA EviEM

EVIDENCE-BASED ENVIRONMENTAL MANAGEMENT

We aim for environmental management to be placed on a scientific foundation. Through systematic reviews and maps of various environmental issues, we aim to improve the basis for decisions in environmental policy.



Cochrane

Trusted evidence
Informed decisions
Better health

Environmental research

Stakeholders

Systematic reviews

Monitoring Evaluations

Advice/recommendations to stakeholders

Evidence-based environmental management

Swedish Agency for Marine and Water Management

Jordbruks verket

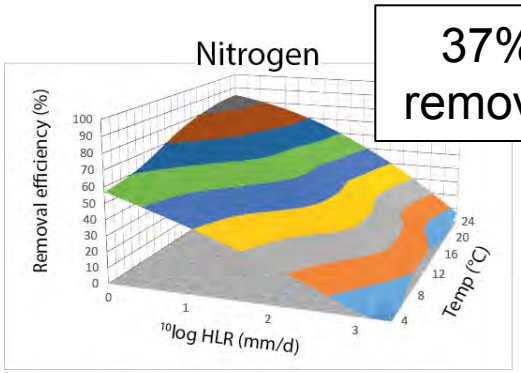
MISTRA EviEM

EviEM systematic reviews related to SDG 6

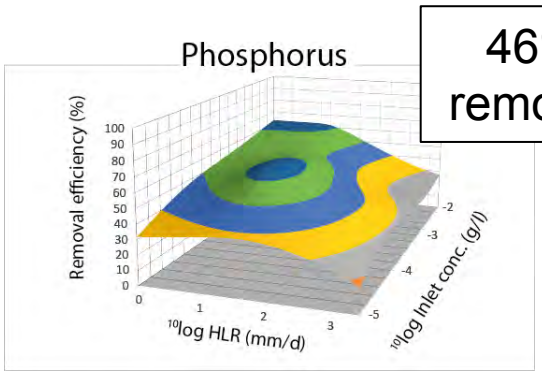
Target 6.3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally

- How do we do this effectively?
- Are we successful?

How effective are created or restored freshwater wetlands for nitrogen and phosphorus removal?

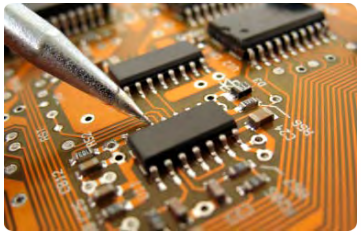


37% removal



46% removal

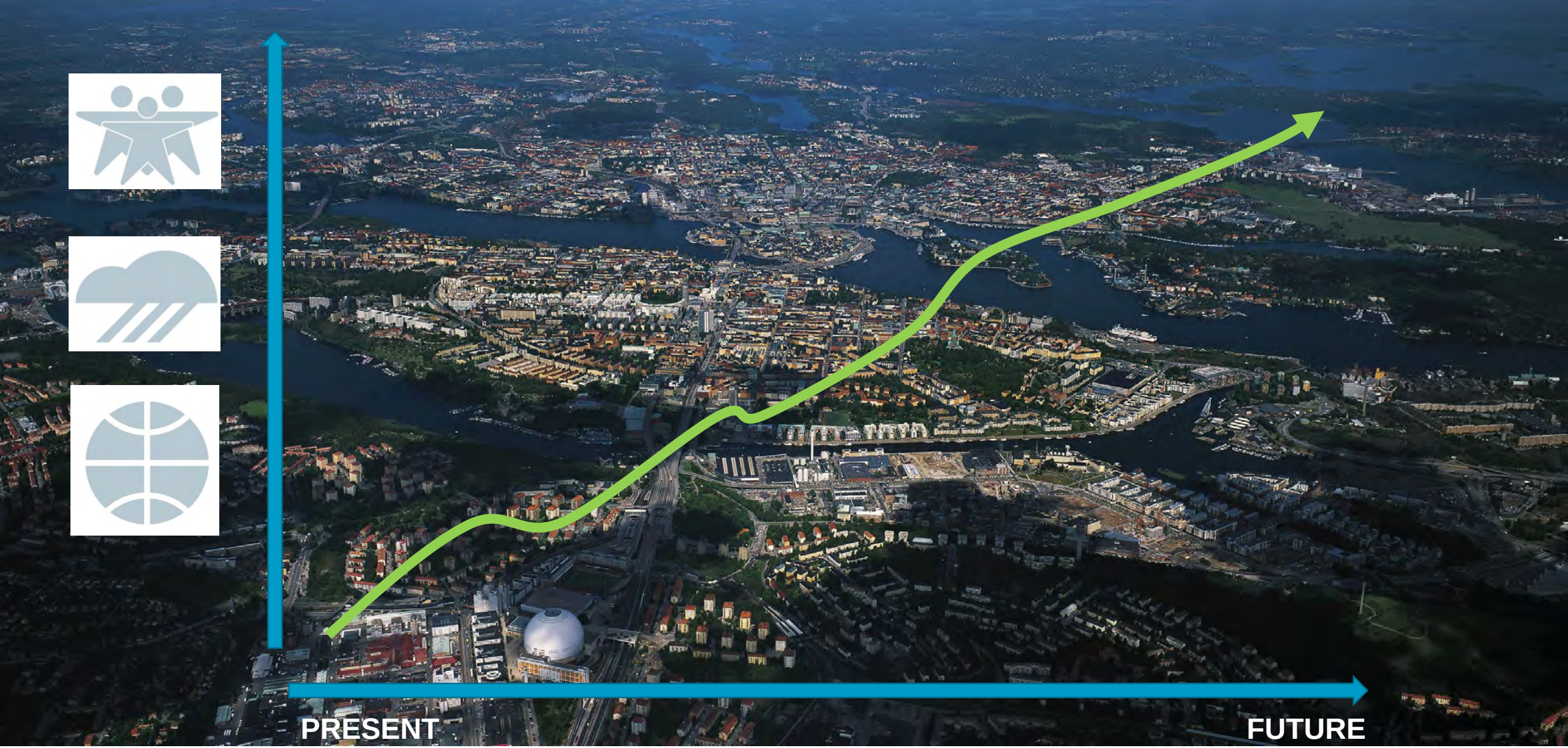
What is the effect of phasing out long-chain per- and polyfluoroalkyl substances (PFASs) on the concentrations of perfluoroalkyl acids and their precursors in the environment?



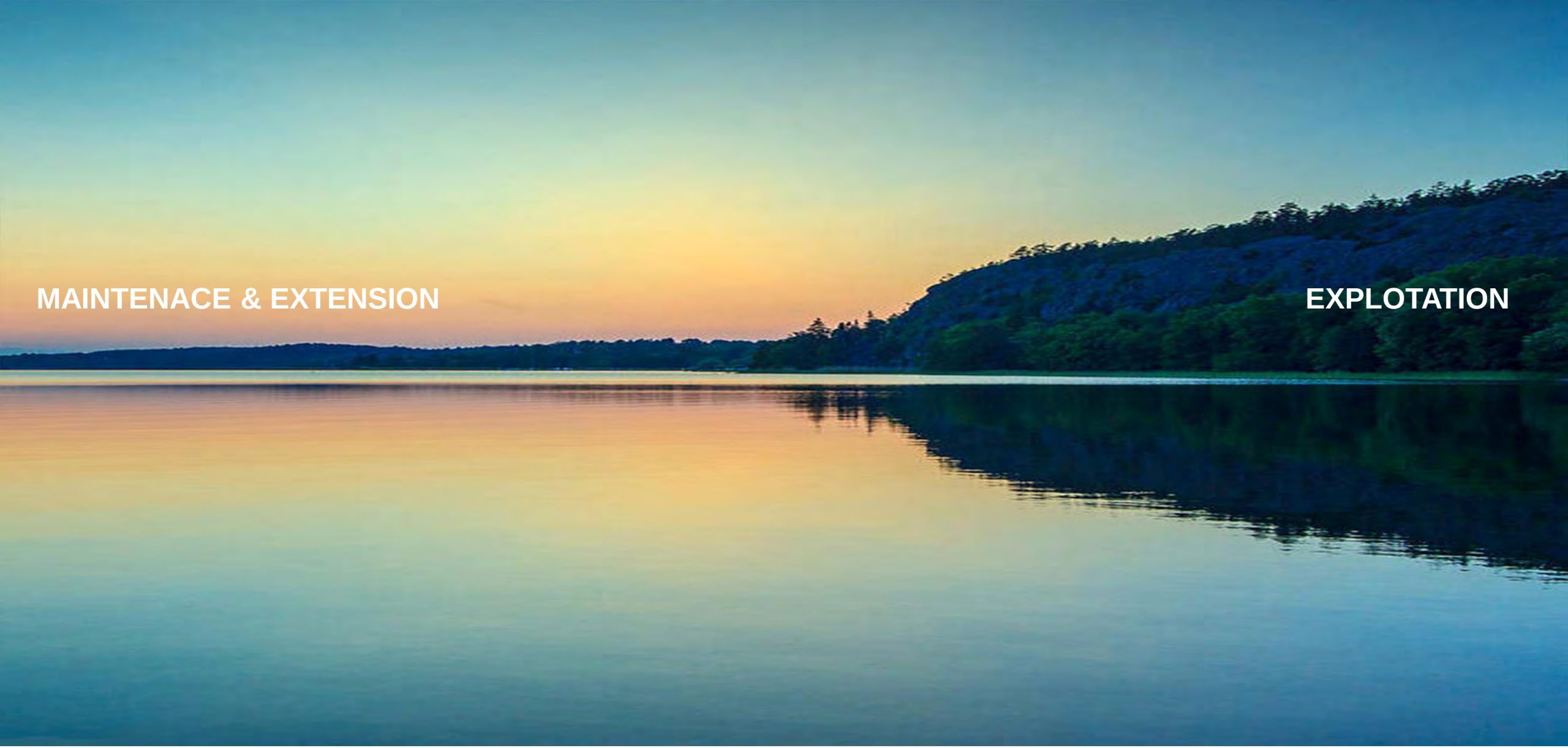
Small group discussion

- Do water and sanitation need to be considered as ‘part of the water cycle’ ? Why or why not
- How should targets in Goal 6 be addressed in an integrated way?
- What new approaches, methodologies or frameworks are needed to do this?

10 minutes discussion and then report back to group



STOCKHOLM VATTEN OCH AVFALL



Currently: ~ 600 projects running, total budget: ~ 6 300 000 000 SEK
M&E 15% EXPL 85%

STOCKHOLM VATTEN OCH AVFALL

Resource Recovery from Waste(water)

ZEYNEP CETECIOGLU GUROL

SCHOOL OF CHEMICAL SCIENCE AND ENGINEERING

DEPARTMENT OF CHEMICAL ENGINEERING

RESOURCE RECOVERY DIVISION

Resource Recovery from Waste(water)

- Energy Recovery
  - Biomethane Production
- Feedstock Recovery
  - Short Chain Fatty Acid (SCFA) Production and Recovery
    - Bioplastic Production
    - Biodiesel Production

} from SCFA-riched effluent

Aim:
Developing an integrated process to enhance SCFA production for recovery and valorization as a sustainable carbon source.

Concept:
Understanding the diversity and metabolism of active microbial populations in acidogenic reactors, constructing synthetic microbial communities and optimisation of the conditions for SCFA production and recovery/valorization.

Enhancement of Volatile Fatty Acid Production from Dairy Wastewater-*EnVFAPro*

- The aim of *EnVFAPro* is to develop a microbial consortium for maximizing VFA production from dairy industry wastewater by bioaugmentation.

- For this purpose, engineering and microbiological tools in combination with a modelling approach are being used.

MARIE CURIE ACTIONS

VINNOVA

David Nilsson: david.nilsson@abe.kth.se

- Director at WaterCentre@KTH
- PhD in history of science and technology
- MSc in Environmental Engineering
- worked in private sector (VBB / Sweco, Hifab, own company)
- worked in government (Sida: Stockholm, Nairobi, Harare)
- enjoys looking at the big picture of things

My challenges

- EQUITY: how can system innovation in urban WASH benefit low-income consumers in informal areas, beyond pilot-scale?
- SUSTAINABILITY: how can large socio-technical systems transition towards resource efficiency?
- COLLABORATION: how to make people from different disciplines, different organisations, and different parts of the world see and think together?